Elliptic flow from two- and four-particle correlations in Au + Au collisions at $\sqrt{s_{NN}} = 130$ GeV[1]

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Elliptic flow holds much promise for studying the early-time thermalization attained in ultrarelativistic nuclear collisions. A related open issue is the extent to which hydrodynamic models and calculations which approach the low density (dilute gas) limit can describe the data. Among the effects that can complicate the interpretation of elliptic flow measurements are azimuthal correlations that are unrelated to the reaction plane (non-flow correlations). It is found that four-particle correlation analyses can reliably separate flow and non-flow correlation signals, and the latter account for on average about 15% of the observed second-harmonic azimuthal correlation, with the largest relative contribution for the most peripheral and the most central collisions.

The ratio of the four-particle cumulant results to the two-particle standard method results are shown in Fig. 1.

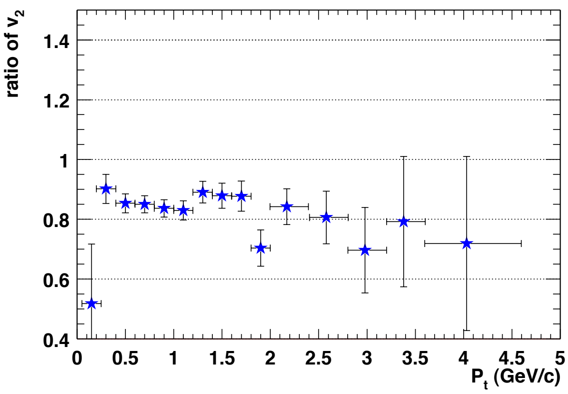

FIG. 1: The ratio of v_2 from the 4th-order cumulant divided by v_2 from the standard method as a function of p_t, averaged over all centralities from bin 2 through 7.

Four-particle correlation analyses reliably separate flow and non-flow correlation signals, and the latter account for about 15% of the observed second-harmonic azimuthal correlation in year-one STAR data. The cumulant approach has demonstrated some advantages over the previous alternatives for treating non-flow effects. In particular, 4th-order cumulants allows us to present v_2 measurements fully corrected for non-flow effects, in contrast to the earlier analyses where the non-flow contribution was partly removed and partly quantified by the reported systematic uncertainties. It is observed that non-flow correlations are present in $\sqrt{s_{NN}} = 130$ GeV Au + Au events throughout the studied region $|\eta| < 1.3$ and $0.1 < p_t < 4.0$ GeV/c, and are present at all centralities. The largest contribution from non-flow correlations is found among the most peripheral and the most central collisions.

On the other hand, a 4th-order cumulant analysis is subject to larger statistical errors than a conventional pair correlation analysis of the same data set. In the case of year-one data from STAR, the intrinsic advantages of a higher-order analysis are somewhat offset by the increased statistical errors, but in the case of future studies of larger numbers of events, this higher-order analysis will provide a clear advantage.

We also present STAR data for v_2/ε, elliptic flow in various centrality bins divided by the initial spatial eccentricity for those centralities. Mapping centrality onto a scale of charged particle density enables us to study a broad range of this quantity, from peripheral AGS collisions, through SPS, and ending with central RHIC collisions. Within errors, the STAR data follow a smooth trend. No evidence for a softening of the equation of state or for a change in degrees of freedom has been observed. We also find that v_2/ε at STAR is consistent with having just reached the hydrodynamic limit for the most central collisions.

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[1] Condensed from Phys. Rev. C **66**, 034904 (2002).